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ABSTRACT

Individuals of all ages hold coherent, theory-like beliefs in a variety of realms that may be at odds with formal, academic theory. Research on such informal theories suggests that individuals may develop key concepts in ways that are ontologically incompatible with the same concepts as they exist in formal or academic theories. This incompatibility may be a major obstacle to learning formal versions of theories. In a study that used previous work on concept development, nine individuals were interviewed about their informal theories of child development. Subjects included three first-year university students, three experienced early childhood teachers who had 7-10 years in the classroom but were not themselves parents, and three experienced parents of 2-3 children, each in grade school. Interview questions focused on three themes: What are children like? How do children change over time? and, How do children differ from each other? Results showed that all subjects held coherent theories about child development, with important differences in ontological emphases. Students described child development as an abstraction more than teachers, who described the concept in terms of here-and-now choices made by very young children, or parents, who described the concept in terms of personal biography and long-term change. (AC)

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What Develops in Informal Theories of Development?

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RUNNING HEAD: Informal Theories of Development

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Abstract

Research on informal theories suggests that individuals may develop key concepts in ways that are ontologically incompatible with the same concepts in formal or academic theories. The incompatibility may be a major obstacle to learning formal versions of theories. Using previous work on concept development by Keil (1989) and Chi (in press), this research explored this possibility by interviewing nine individuals about their informal theories of child development, and assessing their concepts of development. The concepts were assessed in the light of three fundamental ontological categories: material substance, events, and abstract ideas. Results showed substantial philosophical differences among the individuals' informal concepts of development, and these were related plausibly to individuals' personal experiences and background.

What Develops in Informal Theories of Development?

In recent years, research has suggested that individuals hold coherent beliefs in a variety of realms which are theory-like. Informal theories develop, for example, in physical mechanics, in biology, and in cognitive psychology (Carey, 1988; Keil, 1989; Wellman, 1990). Beliefs in these areas qualify as theories because they consist of concepts with mutually dependent meanings, and because change in any one concept or principle necessitates change in others. The beliefs are also theory-like in having core ideas which resist disproof, as well as peripheral ideas which modify readily in the face of evidence or experience.

Informal theories are important for educators because they may account for the difficulties encountered by some students in learning formal, academic theories. In science lessons, for example, a student may persistently confuse the notions of heat and temperature, in spite of repeated efforts by the teacher to distinguish these concepts in simple terms. Everyday theories of energy tend to equate the two concepts, whereas scientific thermodynamics makes important distinctions between them--with "heat" referring to an amount of energy, and "temperature" to a rate of energy flow (Wiser, 1990). Many students do not begin making this distinction simply by reading about it or by being told of it.

If they acquire it at all, they do so only as they develop an entirely new, scientific theory of energy to replace their prior informal theory.

Gaps between informal and scientific theories occur over a wide range of ages. Adolescents and adults not versed in science, for example, tend to hold beliefs about force quite contrary to Newtonian physics: they think that moving objects come naturally to rest, for example, unless given more impetus to move (Carey, 1986). Preschoolers, for another example, hold biological beliefs based largely on prior knowledge not of animal, but of human physical functioning (e.g. they believe that a dog is has a spleen only if they already know that people have spleens) (Carey, 1985, 1988). They also develop a set of interrelated beliefs about how the human mind functions, beginning as early as age 2 or 3 (Wellman, 1990).

In spite of this evidence for informal theories, researchers have not reached consensus about the origins and cognitive status of such theories (see Keil, 1989). Can they be interpreted simply as growth in knowledge? Or do they truly represent a reordering of knowledge? Much of the expert-novice literature has argued the former, but more constructivist-minded developmental psychologists have often argued the latter (see Glaser and Chi, 1988, versus Carey, 1988). The issue has major implications for education: its resolution

implies specific ways of organizing curricula, and specific teaching strategies for fostering cognitive change.

Chi (in press) has proposed initial answers to the question of cognitive growth versus cognitive change, at least for scientific areas of expertise. Following work by Keil (1979, 1989), she argues that individuals organize all knowledge into distinct ontological categories--categories about the nature of being or of existence. She argues, further, that individuals often base informal theories on fundamentally different categories than those at the heart of scientific theories. Persistent misunderstandings between informal and scientific thinking is the result.

Judging by previous psychological research (Keil, 1989) and philosophical analysis (Sommers, 1971), the most fundamental ontological categories are quite small in number. For purposes of analyzing cognitive change, in fact, Chi has identified just three categories of entities, each divided into two subcategories: material substances, events, and abstractions. Material substances include both natural kinds (e.g. plants and animals) and artifacts (e.g. manufactured objects); events include both intentional processes (e.g. eating) and constraint-based processes (e.g. the operations of a clock); and abstractions include both emotions (e.g. fear) and cognitions (e.g. mathematical

concepts). Evidence for the psychological importance of these categories comes from several sources, such as responses to semantic category mistakes (Keil, 1979): a cow cannot be "one hour long," for example, because cow is a material substance and one hour long is a quality of an event. Mixing terms and predicates from different ontological categories creates anomalies that are psychologically meaningless.

It remains to be seen whether Chi's ontology is indeed basic to open-ended fields such as early childhood education, but the ontology does account for important misunderstandings in well-structured, scientific fields of knowledge. In reviewing her own and others' work, Chi (in press) points out that novice science students frequently interpret scientific terms as properties of objects, when in fact they should interpret the terms as constraint-based events. Gravity, for example, is believed to be "in" the object called earth, rather than "in" a rule-governed relationship between the earth and other objects such as the moon. This fundamental category mistake leads to pervasive and persistent lack of comprehension of gravitational laws.

Do misunderstandings in open-ended fields such as early education or child development have similar origins in ontological category mistakes? In studying children's concepts, Keil cautions against assuming that open-ended

fields of knowledge pose the same developmental pitfalls and challenges as do more structured areas of expertise (Keil, 1989, Chapter 12). Learning to be a chess-player or a physicist may not follow the same developmental trajectory as learning to be a criminal court judge or an early childhood teacher. In open-ended systems of knowledge, misconceptions may develop for different reasons than in more fully structured fields, and they may persist, transform, or disappear for different reasons as well.

The research reported here tested these possibilities by exploring whether individuals' informal theories about child development--presumably a less than fully scientific field of knowledge--show evidence of fundamental category mistakes, comparable to those found by Chi, Carey and others in more fully scientific fields. The study assumed a "less than fully scientific" status of developmental psychology, based on the history of the field: its continuing use of qualitative studies as well as quantitative ones, and its long-standing alliances with early childhood education and with social policy issues related to children (Kuhn and Meacham, 1983). Individuals' informal theories about child development were investigated and compared with each other, in an effort to determine whether these theories showed basic ontological commitments analogous to those found among novice science students, or among young

children still forming personal theories of biology and of psychology. In later studies these informal ontological commitments will be compared systematically to those held by formal, academic theories about children, but it was beyond the scope of the current research to accomplish this larger analysis.

Methods of Study

Subjects

Nine individuals were interviewed at length about their informal theories of child development. The individuals were selected to have had radically different experiences with children. Three were first-year university students with experience neither as a teacher or parent; three were experienced early childhood teachers (7-10 years in the classroom), but were not themselves parents; and three were experienced parents (2-3 children, each in grade-school). The university students were currently enrolled in an introductory psychology course, but had taken no courses in child development as such. The early childhood teachers had taken extensive practical courses related to children and to child development theory; all three had earned Master's degrees in the past. The parents also had university degrees, but not in child-related fields: one in journalism, another in nursing, and the third in fine arts. The

parents and teachers were older (35-45 years) than the university students (18-20 years). All of the subjects were female.

Choosing individuals with different experiences about children was done deliberately to highlight diversity, if it existed, in informal theories about child development. I assumed that informal theories evolved largely out of personal experience, which I construed broadly to include family relationships, educational experiences, and individual biography. Formal academic training in child development might contribute to informal theories, as (possibly) in the cases of the teachers; but formal training was neither necessary nor sufficient for developing such theories.

Interviews

Each person was interviewed about her informal theory of child development for a total of about three hours, split into three sessions one week apart. The first session lasted about 90 minutes, and was the most open-ended and exploratory of the three; the second and third sessions lasted about 60 minutes and 30 minutes respectively, and focused increasingly on follow-up and clarifications of ideas expressed in earlier interviews.

Because of the interconnected, complex nature of informal theories, the interviews themselves encouraged open-ended, rich responses. In general,

questions focused on three themes: 1) what are children like? 2) how do children change over the long term? and 3) how do children differ from each other? Individuals were encouraged to respond to these questions at length, and numerous follow-up questions were asked to clarify ambiguities and to insure that responses stayed relevant to the original purposes of the study. All subjects were quite comfortable with this procedure, and talked willingly and at length.

The first interview for each individual was transcribed and analyzed informally before the second interview occurred. Key terms and ideas (e.g. a subject's definition of child) were identified from the transcript, and made into a focus of the second interview, which invited clarification of the terms and ideas. During the second interview as well, individuals constructed a hierarchical, ordered tree visually depicting relationships among several dozen of the terms and ideas which they had talked about during the first interview. Procedures for making and interpreting ordered trees are described elsewhere (Roehler, et al., 1990). Data from the second interview therefore consisted of an ordered tree, written notes about each individual's explanation of key terms, and written notes about the individual's ordered tree.

After the second interview, the transcripts, notes, and ordered tree were reviewed again, but this time written annotations were added to all three documents. The annotations interpreted and summarized comments and information provided by the subject--sometimes in a brief phrase or two, but sometimes also in long paragraphs. The third interview presented the annotated materials to the subject for comment and further clarification. The intent at this point was to insure that I, as investigator, was understanding the subject's personal theory of child development accurately or fairly. Subjects were invited to modify and elaborate on the written annotations during the third interview, and they were invited to add their own written annotations as well.

This sequence of steps worked well with each subject. Triangulating information sources for each person helped to insure relatively valid representations of the informal theories (Merriam, 1988). Final data therefore consisted of transcripts, annotations, and ordered tree diagrams for each subject--approximately 50-60 pages of material for each of the nine subjects. The materials presented a coherent view or informal theory about children for each individual, though as explained below, the views varied significantly among individuals.

Results

Analysis of the transcripts, notes, and ordered trees suggested not only that all subjects held coherent theories about child development, but also that they their ontological emphases or commitments differed importantly. To simplify a bit, students described "child development" more as an abstraction than did either the teachers or the parents. The teachers described the same concept in terms of here-and-now choices made by physically present, but very young children. And the parents described the concept in terms of personal biography and long-term change. These differences can be understood by examining examples from the transcripts of three of the individuals--one student, one teacher, and one parent. The other 6 subjects showed similar differences to these three individuals, but space does not allow describing them all in this proposal.

First consider Robin, a nineteen-year-old university student with no academic background in child development, nor any practical experience working with children. Robin offered primarily generalities in describing childhood and child development. At no time in her 40 pages of interview transcript, did she mention any specific child whom she had known, including her own self as a child. She also spoke largely in an "eternal now" throughout her interviews: "I think that attention grows as you grow older....When they're

younger, they don't focus thoughts...." The tendency to generalize sometimes caused Robin to make unwarranted generalizations: "I've never seen a child of 2 or 3 that did not have a really bad temper," she said, even though she also said she had never spent time with children of this age to any significant extent.

Robin described many general landmarks of development, and tied them to specific ages: the acquisition of language (age 2), making new friends (age 4-5), becoming imaginative (age 6), acquiring interest in boys (age 10-11). These did all not correspond in content, timing, or importance with the landmarks published in academic literature, but they did convey an underlying "ages and stages" view of child development. As in academic versions of ages-and-stages theory, what Robin lacked was a clear statement of the processes by which children moved from one landmark to the next.

A rather different theory emerged from Lori, an experienced early childhood teacher without offspring of her own. Repeated questioning suggested that Lori regarded "child development" not as an abstract idea, but as a concrete event with special characteristics. In particular, development was an event that happened only to very young children--roughly age 2 to 5--and it was marked by children behaving autonomously: "What's important to know

[about children developing] is how they regulate themselves...and what they choose each day." After about age 5, development simply did not occur: "I'm never happy about the differences between preschool and school-age children...You get the cookie cutter kid. Start stamping them out, and they look alike and act alike."

In Lori's view, development was neither a process nor an abstract idea, but consisted of specific behaviors she had seen repeatedly in many children. The behaviors by definition demonstrated autonomy or self-choice, and Lori believed she saw them only in children of very young ages. Outside the crucial preschool age-range, children did not "develop," but rather conformed; they acted less on intentions, and behaved more like machines or robots. Unlike Robin, Lori cited numerous specific children from her classes to illustrate her remarks, though none were described in detail. Development seemed less "in" a particular child than "in" a particular kind of behavior.

Lori and Robin both differed from Mary Clare, a mother of two grade-school boys who worked as a nurse in a local hospital. For her, child development was a long-term relationship between parent and child: "I think [development] is reaching out into the world, coming back to touch base at home, and reaching out again. As the years go by, they reach further, but

never stop coming back." Mary Clare emphasized the longitudinal quality of development--"It lasts 50 to 80 years," she said, "even though it starts early." She also emphasized its specific, material quality, by referring frequently of her own children, and even to her own childhood. Child development was not an abstract idea, as it was for Robin, nor was it specific behaviors, as it was for Lori; it was the story of a relationship.

Consistent with these emphases, Mary Clare told numerous anecdotes about her own family. "There was Adam [one son] and I sprawled on the coach. I had towels all over me because he would throw up every time he'd eat. And he had been nursing and he looked up at me with his big, brown eyes, and I knew we were related." Judged overall, in fact, Mary Clare's transcript resembled a biography; or more accurately, it resembled biographies of several individuals woven together and told simultaneously. Perhaps for this reason, and also because of her focus on cross-age relationships, Mary Clare resisted naming periods, stages, or landmarks of individual development, declaring them all artificial: "I don't really know when a person stops being a baby and starts being a child. It's pretty arbitrary. [Her comment annotated in margin: "Why should this matter, Kelvin?"]"

Educational Significance

These interviews indicate, first, that individuals do hold informal theories about child development, and second, that the theories differ in ways that are ontologically significant. It is possible to view child development as a property of an abstract idea; or as a property of a short- or long-term event; or of a material substance, of particular real children. The interviews indicate nothing about the relative frequencies of these different philosophical commitments among adults, but they do indicate that the differences can occur.

It seems possible, therefore, that educators and adult students engaged in studying child development can misunderstand each other, perhaps persistently, if they begin educational encounters with differing informal theories of child development. The gaps in understanding would resemble those already documented in science education by Carey (1988), Chi (in press), and others. Essentially, teachers and students in early education training programs might talk past each other even when they seem to be discussing the "same" topic, the development of children. A student might begin his or her training with a personal theory viewing children as material substances, but encounter an instructor with a more abstract or more process-oriented view. Or vice versa. Bridging such gaps might take more time, perhaps, than normally allotted in training courses about child development.

Stated this way, the problem of ontological misunderstanding points sensibly to a research agenda for the future. First comes a need to clarify the nature and frequency of ontological commitments about child development. Do adult early education students, in particular, tend to have different commitments from their university or community college instructors? Partial answers to this question may come out of more structured investigations than the one reported here: for example, by posing specific issues or problems about preschool children which have different solutions, depending on the ontology of the individual.

Clarifying ontological commitments will prepare the way for exploring the conditions under which such commitments change. Can personal beliefs about the nature of child development in fact change under the usual conditions of classrooms and early education training programs, or does change require experiences that are even longer term than these, and higher in impact? It seems likely that the answer will be complex. Most likely, cognitive gaps between early childhood instructors and their students will be due partly to ontological differences, but not entirely. Some gaps may have other causes, such as simple ignorance of key information about children, that are relatively easy to remedy pedagogically. But as Chi (in press) has argued for science

education, these "easy" areas of cognitive change need to be distinguished clearly from "hard" areas resistant to change, so that training in early education can focus more effectively on both.

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Author Notes

Research for this study was completed while I was a Visiting Scholar at the Center for Educational Research, Stanford University, during 1990-91.

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